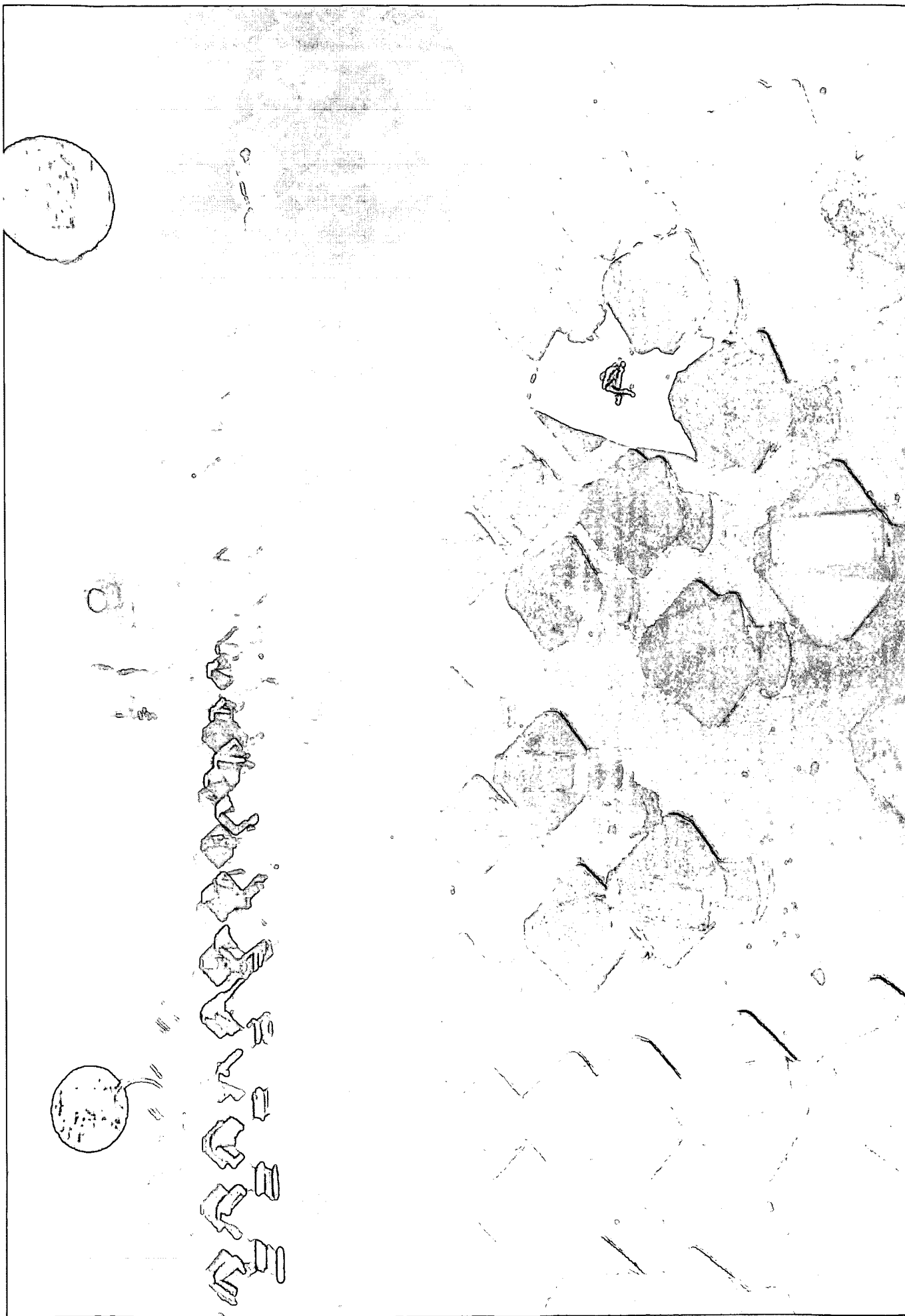


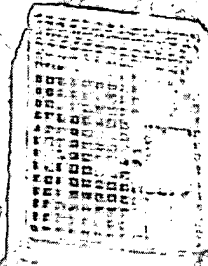
FLEXICOKING Process Description

Gasifier

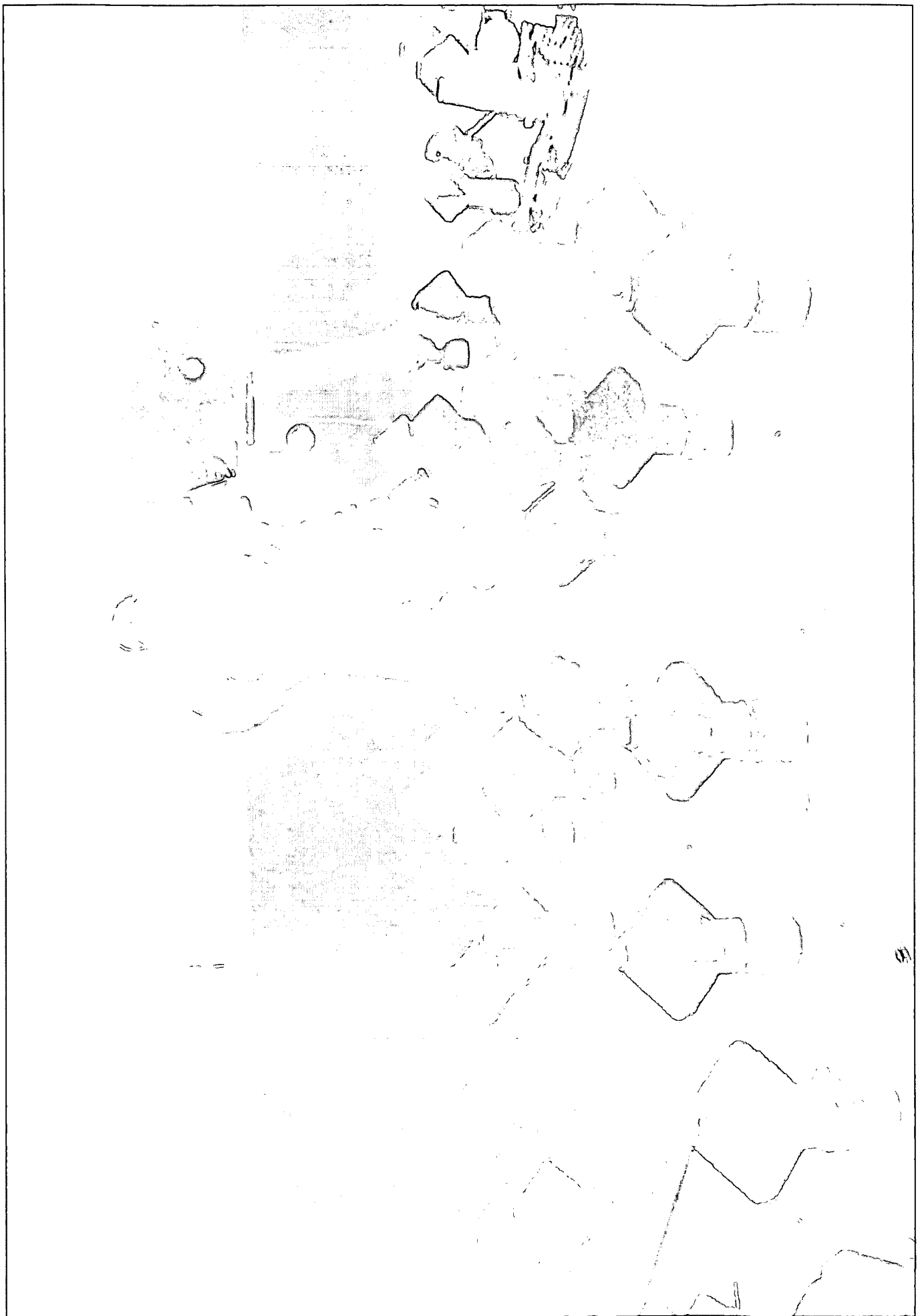
- 900 - 950 °C, 7 meter high fluidized bed, 16 meter diameter
- Coke gasification / combustion

- C + $\frac{1}{2}$ O ₂ →	CO	exo
- C + H ₂ O →	CO + H ₂	endo
- C + CO ₂ →	2 CO	endo
- Gasifies approx. 85-90% of reactor coke production
 - Low Joule Gas contains 50% nitrogen and H₂, CO, CO₂, H₂S and NH₃
 - Temperature control with steam
- Coke circulation for heat transfer and prevents too small coke particles!

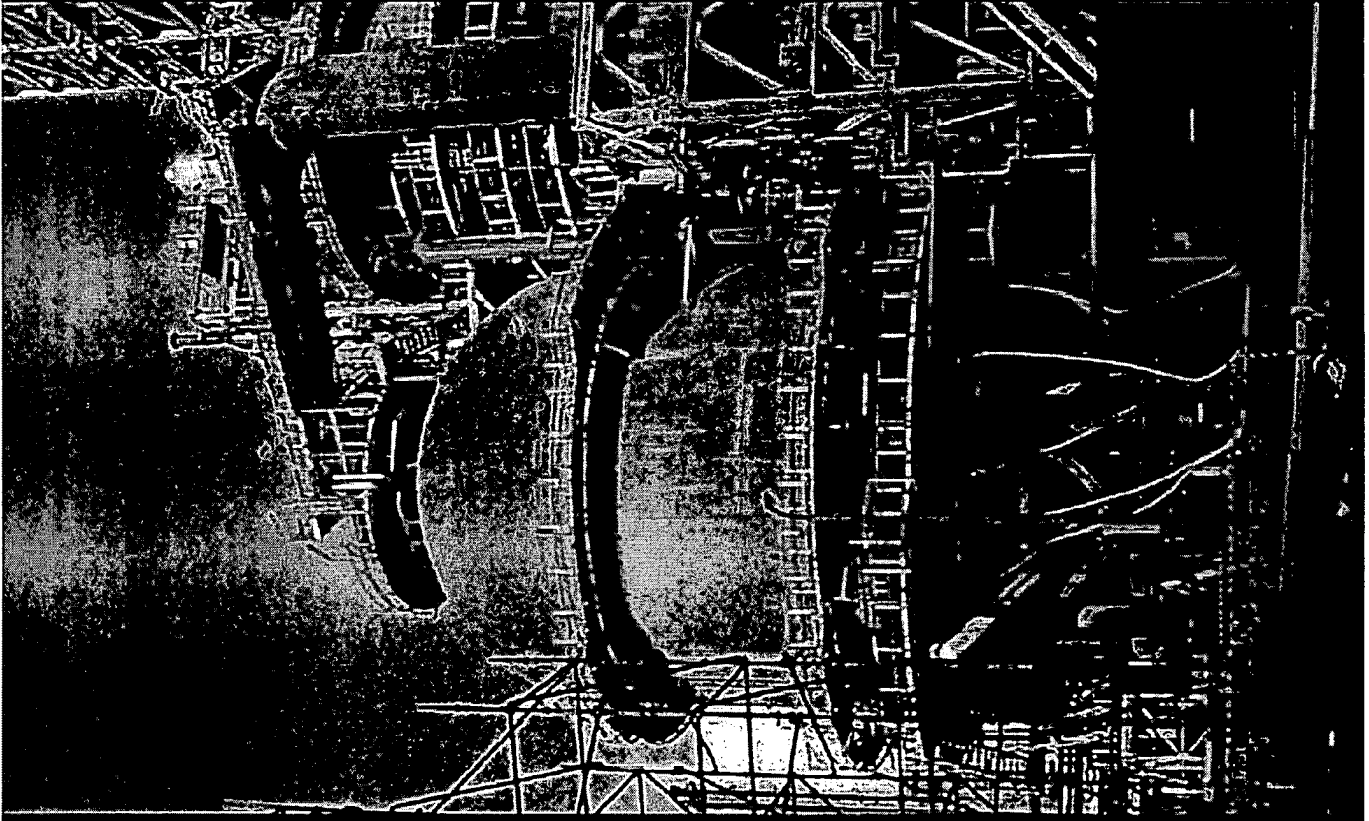








Hot spots



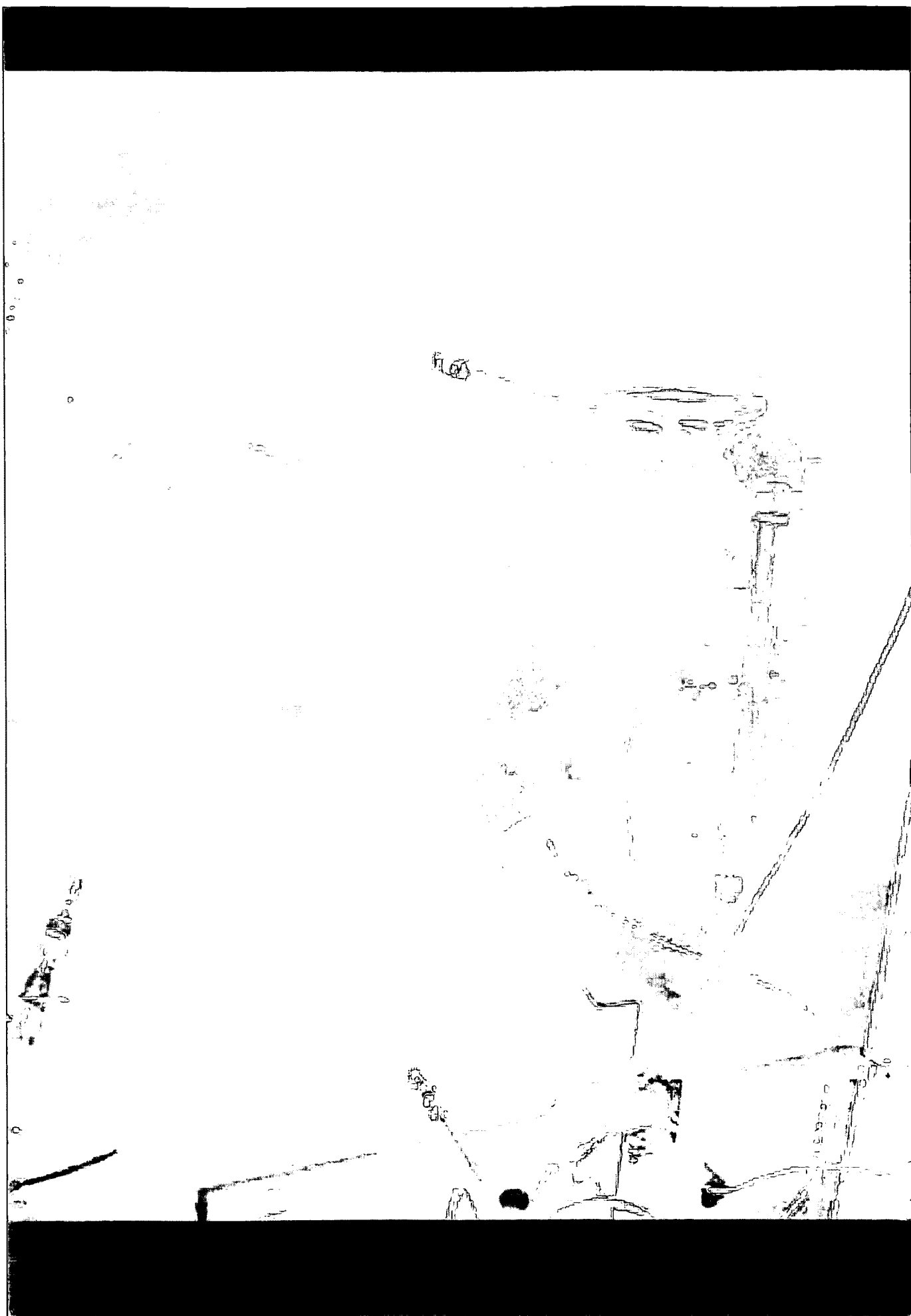
175.0°C

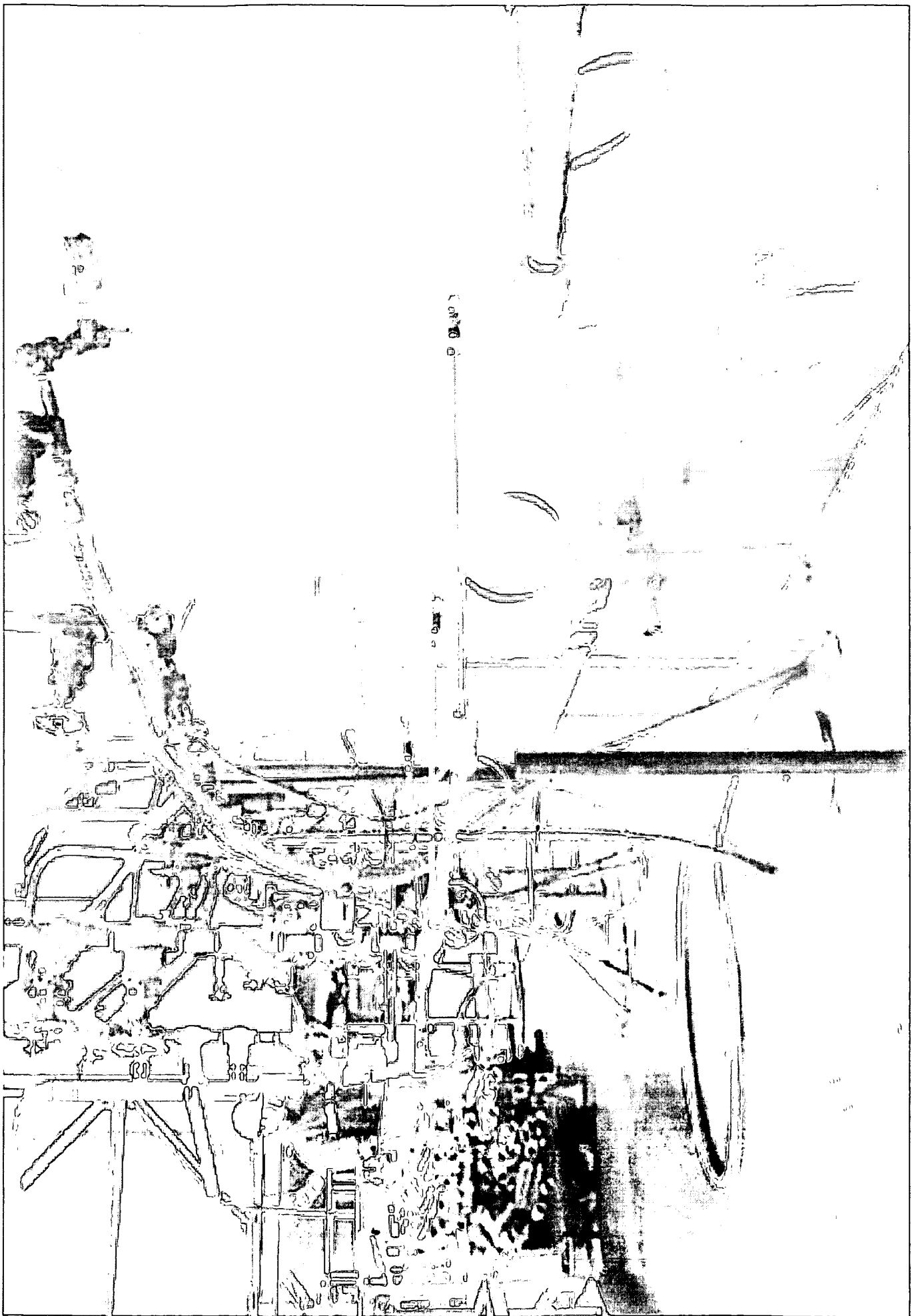
175.0
170.0
165.0
160.0
155.0
150.0
145.0
140.0
135.0
130.0
125.0
120.0
115.0
110.0
105.0
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0

Spot 3
133.2

Spot 2
170.6

Spot 1
168.0





FLEXICOKING Process Description

Coke Transfer lines

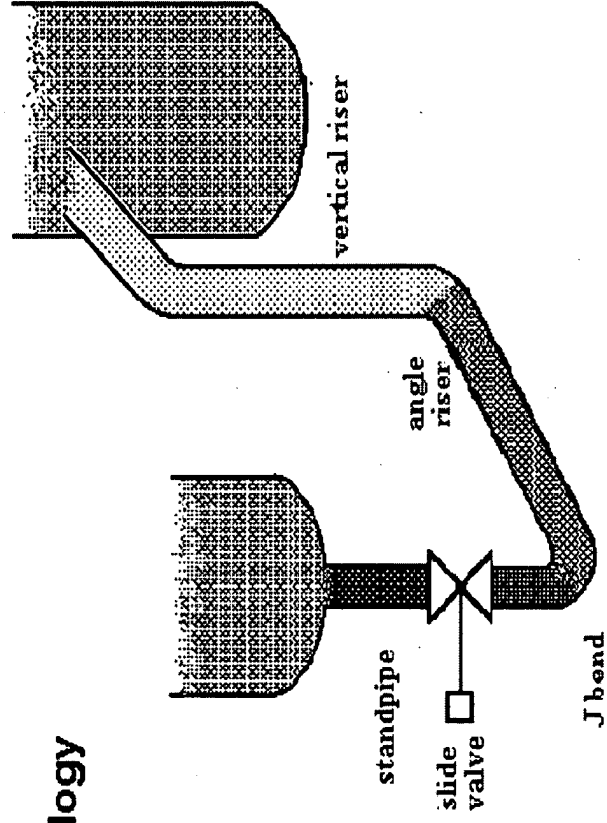
Guess how many ?

- Rx-Hx 3x
- Hx-Gx 2x
- Hx-Qx 1x

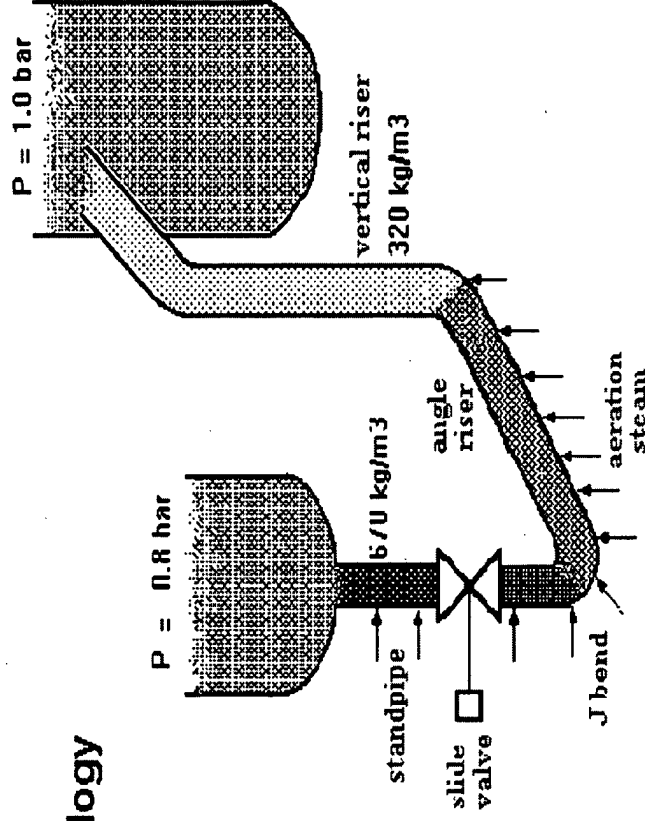
How can you transfer coke against the pressure ?



- Transfer line terminology

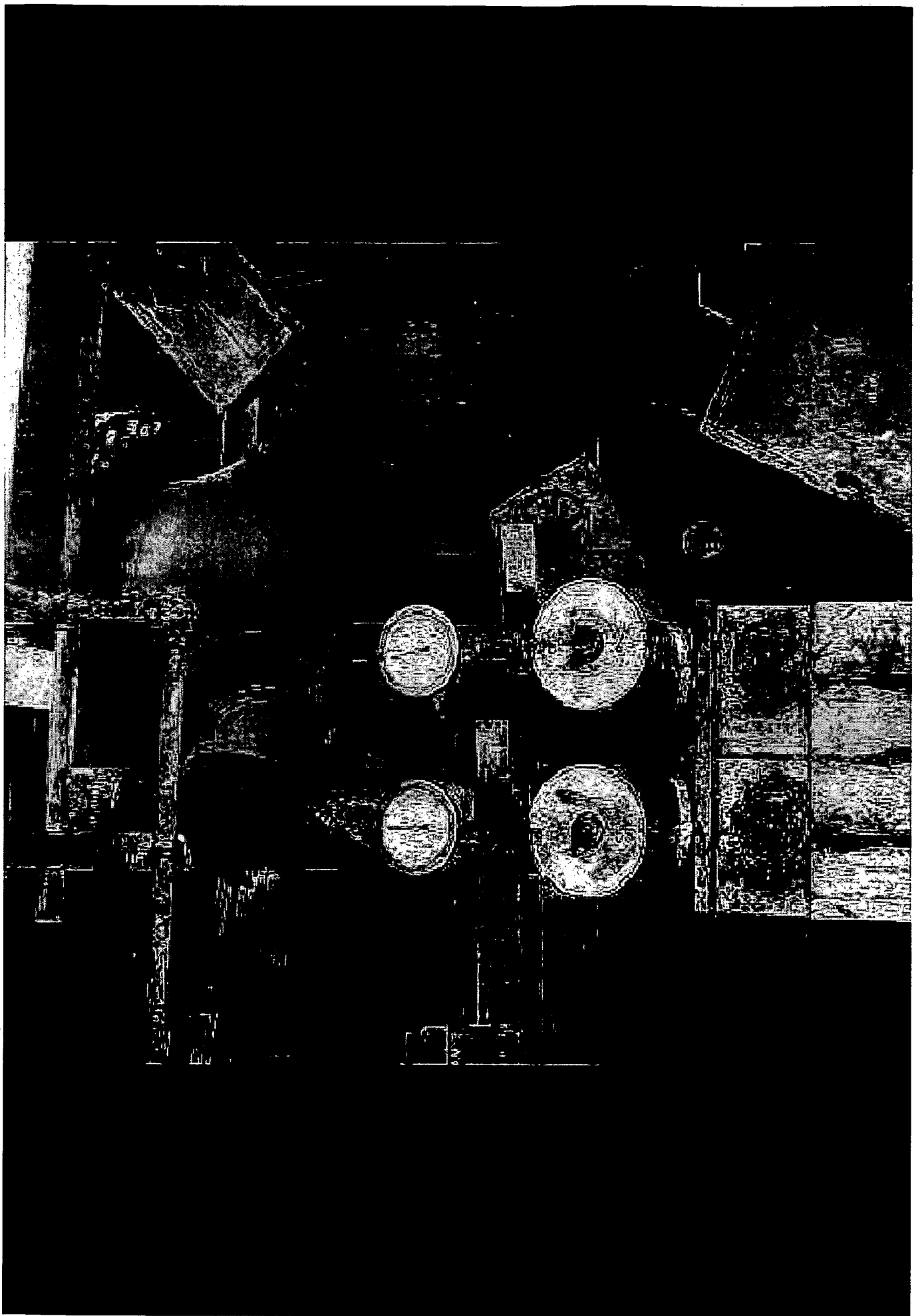


- **Transfer line terminology**

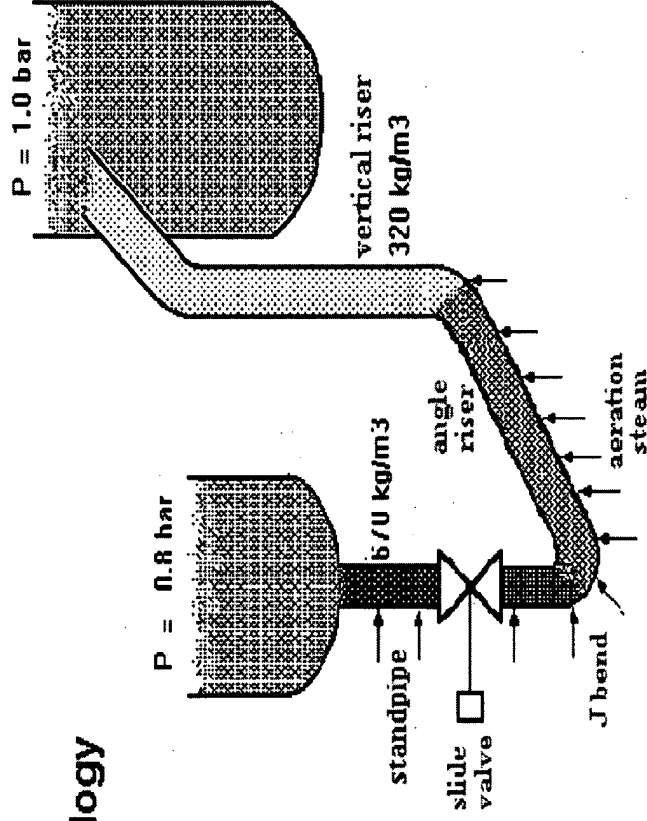


- **Pressure balance**

static pressure build-up in standpipe provides driving force for coke transport
flow control by slide valve or riser aerations



- **Transfer line terminology**



- **Pressure balance**

- static pressure build-up in standpipes provides driving force for coke transport
- flow control by slide valve or riser aerations

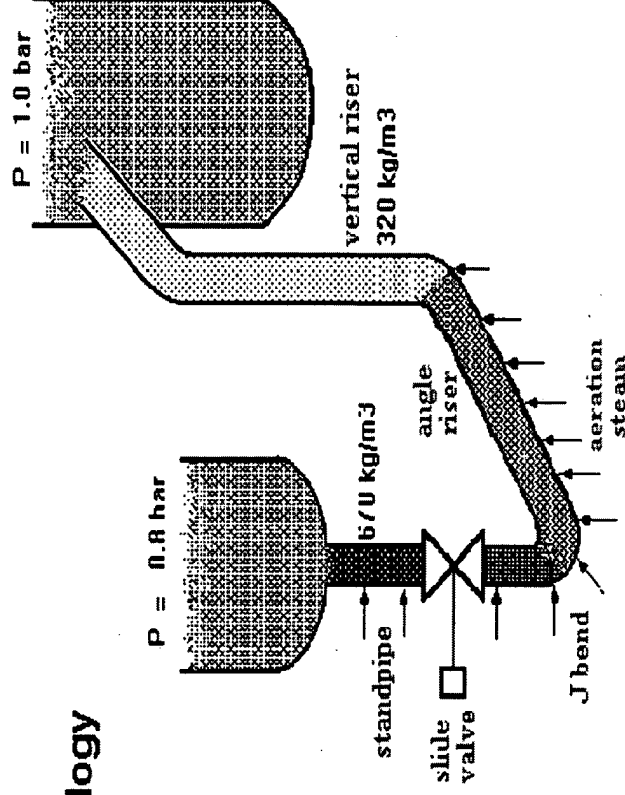
- **Limitations to aeration**

- under-aeration in standpipes results in too low pressure build-up
- too little aeration in risers results in slugging
- too much aeration in standpipes results in too low density and may cause bubbles
- too much aeration in risers causes excessive wear

- **"Bubbles up" or "bubbles down"**

- is determined by velocity differences between gas and particles
- is important for standpipe aeration

- **Transfer line terminology**



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Successes and Disappointments over 17 years

- Significant (33%) capacity creep at low cost
- Runlength doubled; reliability is high priority
- 6 out of 7 runs completed as scheduled
- Air Blower problems 1 year after initial start-up
- Severe fouling in Heater Overhead Exchangers
- Gasifier Hot Spots
- Heater maintenance challenges



Reliability and thruput history

Run	Ton/hr	Days on oil
1	202	591
2	229	608
3	254	570
4	258	684
5	262	1048
6	265	1063
7	269	1195



Reliability and thruput history

Reliability increases effective thruput !

- Good process follow-up and stable operation key to success
- DMC controller installed in 2001
- Some hardware changes essential too:
 spare heat exchangers, material upgrading,
 instrumentation upgrading, design changes
 to reduce turnaround time
- Plan for current run is to increased from 3.5 to 4 years

1988-2003 debottlenecks

- minor Fluid Solids changes
- 2½ new distillation towers
- replaced a number of pumps
- diverted LPG from LPG/coker naphtha hydrofiner



Stretch run length with care :

Unplanned turnaround has high debits

MEuro

1.5

- contractors ask more money for ± same scope

- contractors need 14 days to mobilize

result is additional downtime

4

- turnaround cost spread over shorter run

3.5

- coker down means Pipestill down

jet and diesel to be purchased on spot market

3.5

- next run more conservative approach

2.5

- total additional cost of unplanned turnaround

15

Partial reactor bog terminated run 2 prematurely



Air Blower problems 1 year after initial start-up

*High bearing temperature reading
made entire organization nervous*

- Serious problem or not ?
- Repair required or do we reach turnaround ?
- How to operate the coker and rest of the refinery ?
- How to minimize risk and costs ?
- 2 day case study chemical + mechanical engineers



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• Questions ?

